Age-hardening behavior of Mn or Fe addition Al-Mg_2Si alloy

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In the continuing requirement for automobile weight reduction, the 6000 series Al-Mg-Si alloys has been considered as the promising candidates for age-hardenable bodysheet materials [1]. Transition metals (TMs) such as Cr, Fe and Mn, are usually added to Al alloys for grain refinement [2, 3, 4]. But these TMs will easily form some dispersoids during solidification process [5]. In this work, we changes the additional Mn or Fe content to investigate the variation of the age-hardening behavior for the alloys with different Mn or Fe content. And it will be further clarified the effect of Mn or Fe content on the microstructure in these alloys. The micro Vickers hardness test, transmission electron microscopy (TEM), high resolution transmission electron microscopy (HRTEM) and differential scanning calorimetry (DSC) are used to determine these properties of Al-Mg-Si alloys with different Mn or Fe content.

Fig. 1 shows the TEM bright-field images of the Mn- or Fe-addition alloys. There are only needle-shaped precipitates aligning with $<100>_{Al}$ direction for the six alloys. On the other hand, we can see that the number density of the precipitates in 0.05Mn, 0.1Mn, 0.05Fe and 0.1Fe alloys is higher than that of the base alloy; that of 0.2Fe alloy is similar to that of the base alloy, while that of 0.25Mn alloy is much lower than that of the base alloy. The difference between the number density of the precipitates is attributed to one of the reason for the difference between the peak hardness of the alloys.

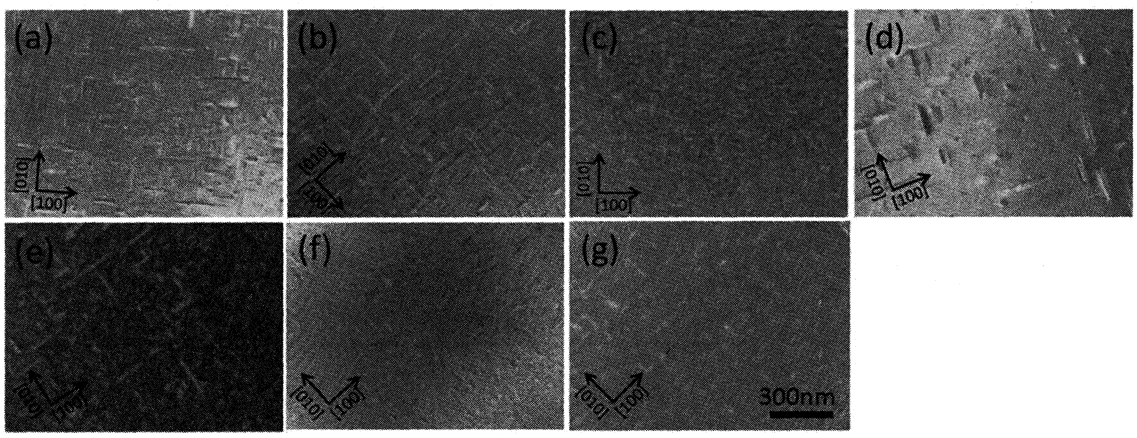

Fig. 1 TEM bright-field images of (a) base, (b) 0.05Mn, (c) 0.1Mn, (d) 0.25Mn, (e) 0.05Fe, (f) 0.1Fe and (g) 0.2Fe alloys peak-aged at 473K.

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